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The Economy and Environment Program for Southeast Asia (EEPSEA) was established in May 1993 to support training and research in environmental and resource economics across its 9 member countries: Cambodia, China, Indonesia, Laos, Malaysia, Papua New Guinea, the Philippines, Thailand, and Viet Nam. Its goal is to strengthen local capacity for the economic analysis of environmental problems so that researchers can provide sound advice to policymakers.

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Environmental Enforcement Under The Spotlight - A Study Of Industrial Pollution Control In China

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To reduce industrial pollution and improve environmental quality, the governments of developed and developing countries have enacted a large number of environmental regulations since the beginning of the 1970s. However, regulations do not automatically lead to an improvement in →

A summary of EEPSEA research report 2008-RR4 'Pollution Taxation in China: The Impact of Inspections' by Liguo Lin, c/o School of Economics, Shanghai University of Finance and Economics, Shanghai, China 200433. Email: liguo_lin@hotmail.com

"Inspections do not significantly reduce...

environmental quality since they may turn out to be ineffective if they are not enforced properly. Highlighting this problem, a new EEPSEA study from China pinpoints a number of flaws in the system used to enforce the country's pollution control legislation.

The study is the work of Liguo Lin from the School of Economics at the Shanghai University of Finance and Economics. He finds that many firms under-report their pollution production levels. This happens when they take part in the self-reporting process that is a key stage of China's pollution control system. His study also shows that, while enforcement inspections do improve the veracity of the pollution reports that firms submit, these inspections do not significantly reduce the amount of pollution that firms produce.

Pollution Control in China

China's recent industrial growth has been extremely rapid. Since the 1980s, industrial output has increased by more than 10% annually. Industry has now become the largest sector in China's economy and accounts for approximately 50% of the country's total GDP. However, this rapid growth has been accompanied by massive amounts of environmental pollution and degradation. For example, almost one third of China's waterways are near biological death due to the excessive discharge of organic pollutants. In many urban areas, atmospheric concentrations of pollutants such as suspended particles and sulfur dioxide routinely exceed World Health Organization safety standards by very large margins. Industry is acknowledged as the primary source of much of this water and air pollution. Indeed, China's State Environmental Protection Agency (SEPA) estimates that industry accounts for over 70% of the nation's total pollution emissions.

In response to this growing challenge, the country has been implementing environmental protection legislation for well over 30 years. Today, the main environmental protection law relating to industrial pollution is based on a pollution levy system. This is a two-tier pollution tax charge system, which levies uniform payments for pollution levels that are 'within standard' and applies higher, escalating rates for above-standard pollution. Under this system all polluters have to provide government authorities with a predicted figure for the volume of pollution they will produce in the coming year. During the year, plants are then required to modify their reports if their actual emissions are different from their predictions. Plants' reports are then verified by field inspections. At the end of each quarter, plants must pay levies on the pollution they produce. In principle firms can be further penalized for violating pollution standards, however penalties are only imposed when firms' pollution exceeds legal standards by a

Descriptive statistics of sample (quarterly data, 2002)

Variables	Mean per quarter	Standard deviation
Value of output (10 million yuan)	4.41	6.52
Number of Employees	443.28	321.66
COD discharge (tonnes)	25.37	53.61
TSS discharge (tonnes)	8.68	17.53
COD concentration (mg/l)	310.99	85.92
TSS concentration (mg/l)	145.78	78.15
Age (decades)	2.29	1.31
Inspection (no. of times)	2.19	1.52
Citizen's Complaints (no. of times)	0.07	0.27
Adapt to Low Rate	62%	
Adapt to High Rate	38%	
Food	37%	
Chemicals	39%	
Paper	15%	
Medicine	9%	
State-owned	25%	
Collective	45%	
Joint-venture	30%	
Number of plants	137	
Number of observations	548	

Notes:

(1) COD means Chemical Oxygen Demand and TSS means Total Suspended Solids. Both refer to the water pollutants measured in this study.

(2) Age means how long the firms have been established.

(3) Adapt to Low Rate means the percentage of firms in the sample that paid taxation according to the lower rate $R\_$ (given that $R\_ < R\_$), and vice versa for the Adapt to High Rate ($R\_$) variable. As shown in Equation 1, there are two above-standard rates for each pollutant: $R\_$ and $R\_$ (taking COD as an example).

(4) Food, Chemicals, Paper and Medicine refer to the sectors.

(5) State-owned, Collective and Joint-venture refer to type of ownership.

(6) Number of observations is the number of firms multiplied by 4 because for each firm there were four observations corresponding to the four quarters of the year 2002.

the amount of pollution that firms produce."

large margin. Local environmental protection bureaus (EPBs) are responsible for most activities relating to the actual implementation of these environmental regulations.

Does the System Work?

In light of the pollution challenge facing China, Liguo Lin set out to see how effective the enforcement of the environmental pollution legislation is. In particular, he aimed to see how polluting firms react to environmental enforcement inspections and whether these inspections help reduce industrial pollution.

The data used in this analysis was obtained from the Fuzhou Environmental Protection Bureau (FEPB). Fuzhou is the capital city of the Fujian province, which is located on the southeast part of China. Over the course of the last decade, Fuzhou's industrial output has increased at an average rate of 12% annually. However, as a result of this rapid expansion, both air and water ambient quality has deteriorated. For instance, in 2006 over 25% of rain was acid and had a pH value of between 5.0 and 5.6.

Liguo Lin assessed information on the COD emissions from 137 plants for the year 2002. Plants that pay levies for COD pollution were selected, as it was felt that these firms were most likely to underreport their pollution in order to avoid levies. The study also focused on the food, chemical, paper and medicine sectors, as these industries are large producers of COD pollution. Quarterly plant-level data was scrutinized to get a good picture of how inspection visits affect plant behavior over time. It was found that, on average, the plants in the study were visited by inspectors twice per quarter. In fact, almost all plants assessed had at least one field inspection each quarter while one plant had 8 inspections a quarter.

Results of emission equations (OLS)
(Sample Size: 411[1])

Independent Variable	COD Discharge		TSS Discharge	
	Absolute	Relative	Absolute	Relative
INS_t	2.0532	1.0974	0.5694	0.0155
	(0.9367)	(0.6705)	(0.3969)	(0.3599)
INS_{t-1}	-0.3612	-0.6399	0.6364	0.6081
	(1.0314)	(0.7383)	(0.437)	(0.3962)
OPT_t	6.8907	4.0358	2.0990	0.1284
	(0.2758)	(0.1974)	(0.1169)	(0.106)
AGE	1.1226	1.1829	-0.0905	-0.4049
	(1.3655)	(0.9774)	(0.5785)	(0.5246)
EMP	-0.0002	0.0032	-0.0056	-0.0035
	(0.0062)	(0.0045)	(0.0026)	(0.0024)
Rate	-6.3792	-3.2934	-0.2427	1.7097
	(3.1447)	(2.2512)	(1.3325)	(1.2082)
Food	-37.9595	-26.8113	-5.7401	2.5821
	(4.6471)	(3.3267)	(1.9691)	(1.7857)
Paper	-34.4710	-27.8507	-2.244	3.6405
	(5.0219)	(3.5949)	(2.2179)	(1.9293)
Chemicals	-28.9541	-19.8509	-3.2032	3.4754
	(4.2442)	(3.0383)	(1.7984)	(1.6306)
State-owned	14.7699	6.7475	7.1409	2.5958
	(3.9503)	(2.8278)	(1.6738)	(1.5176)
Collective	9.7196	5.9849	2.5566	0.0475
	(3.1824)	(2.2781)	(1.3485)	(1.2226)
Constant	14.6644	12.0357	0.2173	-2.0758
	(5.7726)	(4.1324)	(2.446)	(2.2178)
R^2	0.8224	0.7682	0.6924	0.0508

Note: The second row for each variable shows the standard deviations.

Does Self-reporting Work?

To see whether firms were being truthful in their self-reporting Liguo Lin assessed the difference between firms' self-reported emission levels and levels found during inspections (i.e. the amount of pollution for which firms ended up paying levies). His results indicate that, in general, the concentration and volume of COD self-reported by firms is significantly lower than the figures obtained during verification visits. It is therefore clear that firms systematically under report their pollution.

The reason for this widespread under-reporting can be explained by the self reporting procedures which provide firms with room to report 'strategically' in order to minimize the amount of levies they have to pay. For instance, plants can just predict a low level of emissions in their reports at the beginning of a year. They can then decide whether to modify their initial reports depending on how many inspections are subsequently imposed on them. Moreover, under the self-reporting system, when

firms deliver false reports and are caught by the authorities, they are only liable to financial penalties and no other punishments such as the imprisonment of managers or owners (they must pay any evaded levy and between 100% and 300% extra). This means that the penalty for false reporting only involves a capped financial cost – a situation that makes it 'cost effective' for some firms to 'take the gamble' and under report.

To see if environmental inspections have any impact on firms at all, Liguo Lin looked at how inspections affected the actual levels of pollution reported. He looked at the levels of COD and TSS discharge reported by firms (both absolute and relative to discharge standards). He also compared reports that were produced by firms at times when they were being inspected and at times when they were not. He found that when inspections and reporting coincided, this increased the absolute and relative levels of COD pollution self-reported by firms by up to 8.26% and 7.91%, respectively. However, he also found that, when inspections and reports were not done in the same time period, the inspections made no difference to the amount of pollution reported. In other words inspections do not force plants into making actual improvements in their environmental performance. In short, the results show that inspections are effective at making plants report their pollution discharges more truthfully, but they do not actually put pressure on firms to reduce their polluting activities.

Liguo Lin also found that inspections had no significant effects on the reporting of TSS discharges at any time. This finding can be explained by the fact that firms that produce multiple pollutants are only required to pay levies on the pollutant that exceeds discharge standard by the greatest amount; therefore, plants can 'get away' with only focusing on one pollutant and not acting to curb their polluting activity across the board.

How to Improve the Environmental Enforcement System

Liguo Lin's results are in stark contrast with similar studies from the US and Canada which find that inspections do encourage firms to reduce the amount of pollution they produce. The difference between the environmental regulations of these western countries and China goes some way to explaining why this is the case. Most importantly, the US and Canada implement emission standards and heavily penalize companies that produce pollution over these standards (both financially and through legal channels). In contrast China uses emission taxation and allows firms to continue polluting over regulatory levels if they pay the required levy – this gives firms little incentive to clean up their act by, for example, investing in pollution clean-up technology. Moreover, as Liguo Lin shows, China's pollution control system does not provide plants with a strong incentive to even report their emissions truthfully, as there are limited monetary penalties for fraudulent reporting.

Overall, it is clear that if China is to significantly reduce the amount of pollution produced by its industrial growth, then a reform of its environmental legislation is necessary. This reform will have to address not only how polluting firms are penalized, but will also have to revise the procedures for environmental enforcement. Both facets of environmental pollution control must be re-designed so that they provide a real incentive for firms to reduce the amount of pollution they produce. Legislatory reform must also make it much more difficult for firms to falsely report their polluting activities and to carry on polluting - as is the case at present.

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